A.1960-4 U 9/12

AMERICAN INSTITUTE OF PHYSICS

AIP REPORT

335 East 45th Street
New York, NY 10017-3483

EDUCATION & EMPLOYMENT
STATISTICS DIVISION

Tel. 212-661-9404

by Susanne D. Ellis
and Patrick J. Mulvey

AIP Pub. No. R-207.24

July, 1992

1990–91
GRADUATE STUDENT SURVEY

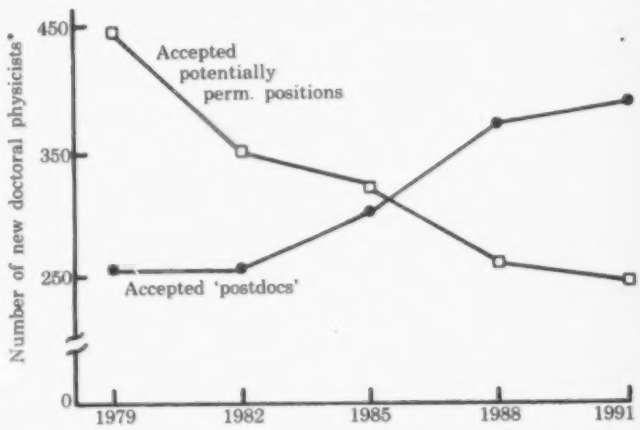
Although there are some 300,000 college students who round out their education by enrolling in one or more introductory physics courses, it is the multinational group of 14,000 graduate students whose serious interest in physics may lead to recommendations on how to address environmental concerns about global warming, to develop new reactor technologies, or to solve the problems of radioactive waste disposal. It is this group of potential physicists and astronomers whom we contact annually and whose contributions to the Graduate Student Survey are analyzed in this report.

There are many ways in which one can interpret the findings of our most recent survey of graduate physics and astronomy students, conducted in the summer of 1991; our approach is one of focusing on changes that, when put into perspective, allow examination as part of a trend. The statistical data produced by our annual Graduate Student Survey provide answers to questions such as: Who studies physics, with what educational background, in what proportions are research specialties chosen, or what career opportunities exist after engaging in graduate work over a period of time that can range from two to ten years. And all interpretations can benefit from the trend data this survey developed over the past thirty years. The highlights of this report are:

- Fewer foreign doctoral graduates than in the previous year were offered permanent initial employment in the U.S.
- Experimentalists were as likely to be offered 'postdocs' as theoreticians.
- Personal funds constituted the source of support of a greater proportion of first-year foreign graduate physics students than in the previous year.

In view of the relatively long time it takes to educate a professional physicist, national goals are apt to change and thereby alter the career opportunities new graduates expect to find. An example of such a changing employment pattern occurred during the 1980s when a gradually rising number of physics doctorates granted each year changed its composition by including a declining proportion of U.S. citizens; it is the changes in their initial employment that we present in **Figure I**. Traditionally these new physicists have had a choice between a temporary postdoctoral fellowship and a potentially permanent position; but the ratios in which those two types of positions were accepted has changed significantly, as shown by the intersecting lines. The employment opportunities for foreign doctorate recipients who wish to remain in the U.S. are more restricted because they hold visas which, by and large, limit their initial employment to one two-year postdoctoral fellowship.

Figure I. Initial employment, in the U.S., accepted by new U.S. physicists.



**The numbers of physicists are scaled-up three-year averages.*

Table I. Characteristics of the graduate physics student population, 1990–91.

Characteristics		All graduate students	First-year graduate students	Degree recipients: terminal masters	Degree recipients: doctorate recipients
	*Total population:	14 065	3 278	674	1 264
	Number of respondents:	8 054	1 764	278	775
Sex	Female	15%	17%	16%*	11%*
	Male	85	83	84	89
Citizenship	U.S.	59%*	58%*	73%	60%
	South & Central America	2	1	–	3
	Europe, Canada, Australia & New Zealand	9	10	4	8
	East Asia	24	24	16	22
	Central Asia & Middle East	5	6	7	5
	Africa	1	1	–	2
Age	24 or younger	17%	45%	12%	–
	25–26	20	17	23	4%
	27–28	22	14	15	26
	29–32	25	15	34	47
	33 or older	16	9	16	23
Physics in high school	Yes	93%	93%	92%	95%
	No	7	7	8	5
Major of bachelor's degree	Physics	89%	87%	71%	90%
	Mathematics	2	2	1	2
	Engineering	7	8	20	6
	Other physical sciences	1	1	3	1
	Other	1	2	5	1
Type of bachelor's institution	PhD-granting	38%	38%	34%	40%
	MS-granting	6	7	15	4
	BS/BA-granting	17	19	25	16
	Foreign	39	36	26	40
Type of graduate institution*	PhD-granting	90%	85%	74%	100%
	MS-granting	10	15	26	–
	Public	71%	74%	78%	66%
	Private	29	26	22	34

* *These data were derived from the survey of Enrollments and Degrees.*

Following a decade of rapid increases in the number of foreign graduate students who entered the United States to study physics, their proportion stabilized at approximately 40%. The citizenship of graduate physics students is one of seven characteristics presented in **Table I**. For each characteristic this table compares the total graduate physics population with three of its subgroups, namely, the first-year graduate students, the terminal masters, and the doctorate recipients. The first two rows of numbers compare the respondents to this year's survey with the total population for each of the four groups. To avoid misinterpreting the data shown for the first characteristic, it should be mentioned that a majority of the women doctorate recipients is foreign. The third characteristic, age, represents an addition to this year's version of **Table I**. The large foreign contingent among the graduate students has the effect of lowering each of the percentages of students who did not take physics in high school. Engineering graduates remain the largest group among the transfer students and comprised as much as 20% of the terminal masters in 1990-91. It is important to note the difference in attrition rates between public and private institutions. The share of first-year students enrolled at private institutions is only 26%, but 34% of the doctorates were conferred by those institutions.

Since certain groups, that are considered minorities in the United States form large proportions of the foreign graduate students, we designed **Table II** to compare the characteristics of each of these groups on the basis of citizenship. The numbers shown in the first row indicate how many graduate physics students, among the respondents to this survey, identified themselves as members of one of those groups. The numbers of degree recipients, on the other hand, were reported by physics department chairpersons as part of another survey. Since the groups vary greatly in size, we use percentages to facilitate comparisons among them. Thus we find that the foreign contingent in each group tends to be older and that U.S. blacks are more likely to be supported by fellowships than the members of other groups.

Table II. A comparison of the characteristics of minority group graduate physics students, 1990–91.

		Black		Native American	Hispanic		Asian Indian		Oriental		Arab	
		U.S.	Foreign	Indian	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
Number of respondents:		74	41	15	91	83	39	319	195	1972	26	105
Characteristics												
Sex	Female	19%	7%	7%	9%	16%	28%	20%	17%	18%	4%	15%
	Male	81	93	93	91	84	72	80	83	82	96	85
Enrolled in degree program	TMS	10%	10%	–	12%	5%	5%	7%	10%	8%	15%	15%
	Doctoral	85	90	93%	87	95	95	91	88	91	81	84
	None	5	–	7	1	–	–	2	2	1	4	1
Age	<24 yrs	10%	2%	7%	16%	5%	31%	19%	27%	10%	23%	10%
	25–26	27	10	27	22	11	28	23	25	13	12	22
	27–28	15	12	27	15	17	18	20	16	23	12	17
	29–32	20	25	32	33	45	10	23	22	33	34	20
	>33 yrs	28	51	7	14	22	13	15	10	21	19	31
Full-time equivalent years of graduate study	< 1	23%	22%	13%	19%	21%	26%	20%	25%	20%	23%	31%
	2	24	24	27	21	13	18	16	20	19	35	19
	3	16	22	13	18	24	23	14	15	15	8	14
	4–5	24	22	27	23	27	18	29	21	28	19	12
	> 6	13	10	20	19	15	15	21	19	18	15	24
Source of support	Teaching ass't	14%	43%	47%	23%	41%	21%	47%	23%	40%	31%	48%
	Research ass't	22	24	20	29	36	39	42	42	47	27	35
	Fellowship	37	15	27	31	7	26	3	15	4	15	3
	Personal funds/ other	27	18	6	17	16	14	8	20	9	27	14
Number of graduate degree recipients*	TMS	9	5	1	6	7	10	31	21	118	4	3
	Doctorates	6	8	–	9	29	6	50	20	340	2	23

** These data were derived from the survey of Enrollments and Degrees.*

Much emphasis is placed on knowing in what proportion graduate students choose each of the major areas of concentration, though that choice need not be decided on until the required course work for a graduate degree has been completed. But from **Table III**, which lists the ten major subfields, we find that the majority of graduate students make such a choice early on.

Table III. Number of graduate physics students, by subfield* and years of graduate study completed, 1990–91.

		Full-time equivalent years of graduate study									Total graduate students	
		< 1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	>9 yrs.	N	%
Distribution of students	N	3278	2810	2070	1855	1685	1150	620	330	267	14 065**	
	%	23.3	20.0	14.7	13.2	12.0	8.2	4.4	2.3	1.9		100%
Astrophysics		335	210	125	145	125	75	35	15	20	1085	7.7
Bio/medical physics		115	120	65	65	50	35	20	10	15	495	3.5
Condensed matter		960	840	735	675	580	430	210	130	80	4640	33.0
Electron, atomic, molecular		205	180	170	140	130	95	60	35	25	1040	7.4
Elementary particles		365	315	240	265	265	150	105	45	35	1785	12.7
Mathematical physics		210	215	145	110	85	45	25	20	15	870	6.2
Nuclear physics		195	155	160	130	160	100	60	15	25	1000	7.1
Optics/lasers		280	200	115	95	95	65	25	20	5	900	6.4
Plasmas/fluids/chaos		100	130	100	90	80	60	35	20	30	645	4.6
Physics applications		205	225	90	50	45	40	30	5	15	705	5.0
Other subfields		308	220	125	90	70	55	15	15	2	900	6.4

** The distribution of students in each subfield is based on 7834 respondents to this question.*

*** The total was derived from the survey of Enrollments and Degrees.*

Table IV. Sources of support for graduate physics students, by type of institution and citizenship, 1990–91.

Source of support		Doctor's-granting institutions				Master's-granting institutions			
		U.S. students		Foreign students		U.S. students		Foreign students	
		First-year students	Advanced students	First-year students	Advanced students	First-year students	Advanced students	First-year students	Advanced students
Teaching assistantship		46%	21%	61%	35%	33%	28%	48%	60%
Research assistantship		13	52	19	54	9	10	18	20
Fellowship		23	16	8	6	2	3	2	2
Foreign government		–	–	2	2	–	–	2	3
Family, savings, loan		3	2	7	2	10	13	22	7
Full-time employment		7	5	1	–	37	36	3	5
Other*		8	4	2	1	9	10	5	3
		100%	100%	100%	100%	100%	100%	100%	100%
Estimated distribution of all graduate students	N**	1592	5774	1190	4144	298	578	198	291
	%	11	41	9	30	2	4	1	2

* *"Other" includes the military and part-time employment.*
** *These data were derived from Tables VII and VIII in the survey of Enrollments and Degrees.*

Basic questions concerning the sources of support for graduate physics students are answered by the data presented in **Table IV**. In addition to distinguishing between beginning and advanced graduate students, this table separates the graduate enrollment by type of institution and on the basis of citizenship. Thus it becomes clear that teaching assistantships are primarily offered to first-year graduate students at PhD-granting institutions but also to a majority of all foreign students at the master's institutions. Full-time employment appears to be a major source of support for U.S. students who are enrolled in evening programs at master's institutions. By comparing the 1990-91 data with those of the previous year, we found several changes at the master's institutions: The proportion of beginning U.S. students who had accepted either type of assistantship rose significantly; fewer foreign students were offered research assistantships as more of them reported using their own funds.

Table V. Number* of advanced graduate physics students specializing in selected experimental or theoretical subfields by years of graduate study completed, 1990–91.

Physics subfield	Type of research	Full-time equivalent years of graduate study								Total	
		3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	>9 yrs.	N	% Exp.	% Theo.
Astrophysics	experimental	60	70	75	45	25	5	10	290	5.4	
	theoretical	75	70	55	30	10	10	10	260		10.0
Bio/medical	experimental	50	50	40	35	20	5	–	200	3.7	
Condensed matter	experimental	505	450	410	335	190	100	70	2060	38.4	
	theoretical	155	190	130	90	20	30	10	625		24.0
Electron, atomic, molecular	experimental	145	110	90	85	55	35	5	525	9.8	
	theoretical	45	35	45	10	15	5	5	160		6.1
Elem. particles	experimental	145	185	200	110	95	45	20	800	14.8	
	theoretical	105	110	80	55	25	10	5	390		15.0
Math. physics	theoretical	170	120	100	60	25	25	20	520		19.9
Nuclear	experimental	125	105	120	85	45	15	15	510	9.5	
	theoretical	40	30	35	30	15	5	–	155		5.9
Optics/lasers	experimental	90	65	65	50	20	15	10	315	5.9	
Plasmas/ fluids/chaos	experimental	55	60	35	35	10	15	10	220	4.1	
	theoretical	55	35	45	30	30	5	5	205		7.9
Physics applications	experimental	65	45	35	35	20	5	10	215	4.0	
Other subfields	experimental	65	50	50	25	20	20	5	235	4.4	
	theoretical	85	55	70	45	10	15	12	292		11.2
Total	experimental	1305	1190	1120	840	500	260	155	5370	100.0%	
	theoretical	730	645	560	350	150	105	67	2607		100.0%

* *The numbers in this table have been scaled up to reflect the total number of graduate students (7977) who completed three or more years of graduate study.*

The first two years of graduate work constitute the educational core of the PhD program; it is after that rigorous and comprehensive course work that the student chooses a subfield for intensive professional training that ultimately leads to a dissertation. **Table V** relates ten major subfields, grouped by type of research, to the full-time equivalent years of graduate study. For each level of study the table shows the estimated number of doctoral candidates. Graduate students who described their type of research as "computer simulation" were added to the theoreticians.

Table VI. Distribution by subfield and citizenship of doctorate recipients, 1990–91.

Physics subfield	U.S. citizens	Foreign citizens	Total in subfield
Astrophysics	4.4%	1.5%	5.9%
Biophysics	1.4	1.6	3.0
Condensed matter	19.1	16.0	35.1
Electron, atomic, molecular	4.9	3.0	7.9
Elementary particles	11.5	6.6	18.1
Mathematical physics	3.9	2.8	6.7
Nuclear	4.6	2.1	6.7
Optics/lasers	3.3	1.0	4.3
Plasmas/fluids/chaos	1.7	2.2	3.9
Physics applications	2.5	1.2	3.7
All other subfields	2.7	2.0	4.7
Total	60.0%	40.0%	100%

Degree recipients

It is important to recognize that doctorate recipients identify strongly with the subfield of their dissertation; hence **Table VI** presents a listing of the ten major subfields and shows for each one the proportion of U.S. as well as foreign doctoral graduates.

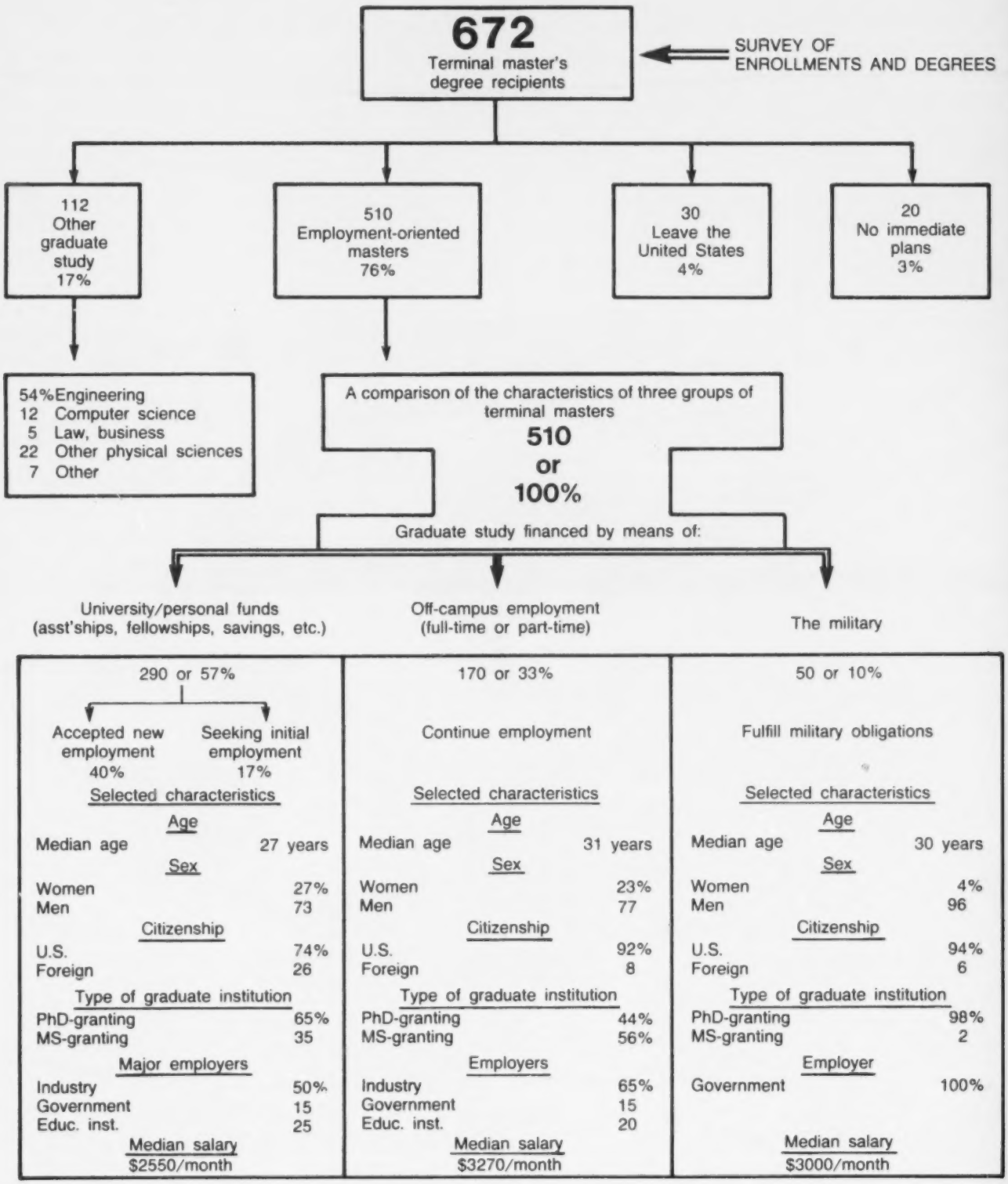
For a comprehensive view of the initial employment reported by the doctoral graduates in 1991, we present **Table VII**. The totals in this table, when compared with the corresponding ones of the previous year, indicated a small shift from permanent positions to 'postdocs' while the percentage of new physicists still uncommitted remained at 6%. But this composite picture obscures some significant changes experienced by the foreign doctoral graduates. Although the proportion that left the U.S. to begin their careers has not changed in five years, among the 80% who remained in this country we found an increase in temporary research positions at universities that we included with the 'postdocs'. Among the U.S. citizens, no net change was recorded for those who opted for 'postdocs' but more of that group left the U.S. to do so. The potentially permanent positions that were available for new physicists in 1991 were filled by 31% of the U.S. graduates compared with 11% of the foreign degree recipients; these two proportions represent decreases of three and seven percentage-points respectively, when compared with the 1990 graduates.

Table VII. Employment of doctoral graduates by citizenship, 1990–91.

Doctoral graduates		U.S. employer 'Postdoc'	U.S. employer Pot. perm. employment	Foreign employer 'Postdoc'	Foreign employer Pot. perm. employment	Uncommitted in the U.S.	Total %	Total N	Total %
U.S. citizens		52%	31%	9%	–	8%	100	456	60
Foreign citizens		65	11	14	6%	4	100	306	40
Total	%	57	23	11	3	6			100%
	N	434	177	84	19	48		762	

Note: Thirteen graduates had no immediate plans.

Figure II. Post-degree plans of physics terminal master's degree recipients, 1990–91.



In the face of changing federal economic policies, employers are more apt to seek a less specialized and more flexibly trained work force. The terminal master's program in physics provides a solid technical training for a large number of professional careers. In 1990-91 close to 700 terminal master's degrees were conferred in physics and **Figure II** outlines the diversified career plans of these graduates. A rapidly growing group of terminal masters is the one that considers two years of graduate-level physics an excellent technical background for graduate work in another discipline; half of the members in this group are foreign and a majority of them transfer to engineering.

Three out of four terminal masters are employment oriented and were led to this degree by a variety of circumstances. There is the group of physics bachelors who started graduate study in physics without interruption but were unwilling to commit six years to a doctoral program. Then there are the physics bachelors who chose immediate full-time employment but were urged by their employers to enroll in a limited graduate program aimed at a specific applied subfield, possibly optics, and stayed with the program until they completed a master's degree. **Figure II** takes the large employment-oriented group of masters and divides them into three subgroups based on how their graduate study was financed. The largest of these subgroups has little work experience, its members were supported by university or personal funds, and one-quarter of them are foreign. The second group of masters returned to school because their employers convinced them that some graduate course-work would be beneficial in furthering their careers; its members include very few foreign graduates, their median age is the highest of the three groups, and they reported the highest median salary. A small but distinct group are the masters whose graduate education was financed by the military. These degree recipients are not competing for jobs because they need to fulfill military obligations and each year the largest single contributor to this group is the Naval Postgraduate School in California.

There are many master's programs where a written thesis is optional; nevertheless, degree candidates are expected to choose an area of concentration. For purposes of comparison with the doctoral candidates, we present a subfield distribution reported by physics masters in **Table VIII**.

Table VIII. Distribution of terminal masters by subfield, 1990–91.

Physics subfield	% of degree recipients*
Acoustics	5
Astro/geophysics	10
Bio/medical physics	6
Condensed matter	23
Nuclear	8
Optics/laser	11
Plasma/fluids/chaos	6
Physics applications	10
Physics education	4
General physics	6
All other subfields	11
Total	100%

* *Based on 278 respondents.*

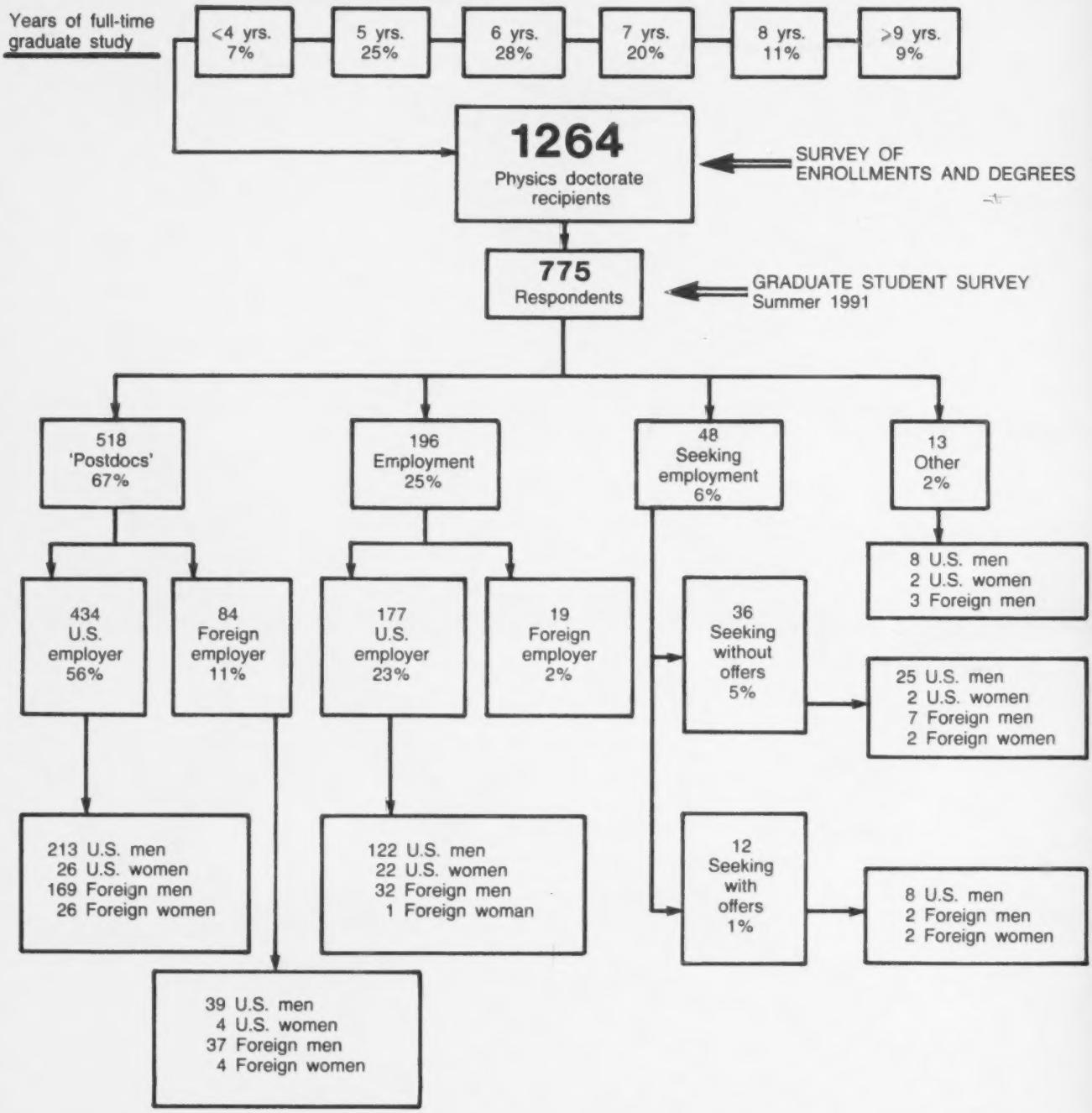
By combining the three subgroups of **Figure II** we present a comprehensive employment picture of the new physics masters in **Table IX**. Here we relate six types of employers to the major work activities and the extent to which these physicists use their training. As recently as five years ago, secondary schools were not listed among the types of employers for physics masters because so few of them even considered these positions. But starting with the class of 1989, the proportions of new masters whose initial employment was in secondary schools were 4%, 7%, and 9% respectively.

Table IX. Employment characteristics and use of physics training of 1990–91 master's degree recipients.

Work activity		Type of employer: Secondary school	Post-secondary institutions	Industry	Government	Military service	Non-profit organization	Total N	Total %
Teaching		37	33	–	–	5	3	78	18
Research		–	11	15	11	–	7	44	10
Research and development		–	–	74	7	3	–	84	20
Engineering		–	–	83	22	–	–	105	25
Programming		–	–	12	7	5	–	24	6
Management		–	3	8	11	5	4	31	7
Nonphysics professional		–	–	20	7	32	–	59	14
Total	N	37	47	212	65	50	14	425	
	%	9	11	50	15	12	3		100%
Use of physics training:	Extensive	27	42	99	32	11	9	220	52
	Little	10	5	104	26	36	5	186	44
	None	–	–	9	7	3	–	19	4

Note: The data in this table reflect the employment information contributed by individual degree recipients as well as department chairpersons.

Figure III. Post-degree plans of physics doctorate recipients, 1990–91.



So as not to duplicate data on characteristics of the doctorate recipients presented in the tables of this report, we used **Figure III** to elaborate on citizenship and sex by type of post-degree employment. For example, a frequent question is one that concerns the employment of U.S. women physicists; using the data in **Figure III** we can calculate that 41% of them accepted permanent initial employment; the corresponding figure for U.S. men was 30%.

As mentioned earlier, it is not only the citizenship but also the subfield and type of research that are crucial in determining what type of initial employment new physicists can secure. To highlight these relationships, we adopted a new format for **Table X** that divides it into two parts, major subfields and types of research, each linked to four employment categories. By listing the six largest subfields in the upper portion of the table, we include over 80% of the

Table X. Initial employment status for physics doctorate recipients by major subfield, type of research and citizenship, 1990–91.

Major subfields		'Postdoc'	Permanent employment	Seeking employment	Leave the United States	Total %	Total in major subfields N	Total in major subfields %
		in the United States						
Astrophysics		66%	25%	–	9%	100	75	6
Condensed matter		57	25	5%	13	100	445	35
Electron, atomic, molecular		52	30	4	14	100	100	8
Elementary particles		67	11	5	17	100	225	18
Mathematical physics		46	21	8	25	100	85	7
Nuclear		61	27	4	8	100	85	7
Total All subfields combined		57%	23%	6%	14%	100%	1015	81%
All experimentalists*	U.S. citizens	52%	34%	5%	9%	100%	564	70%
	Foreign citizens	65	16	3	16	100	237	30
Total		56%	29%	4%	11%	100%	801	100%
All theoreticians*	U.S. citizens	50%	31%	10%	9%	100%	226	51%
	Foreign citizens	64	5	5	26	100	216	49
Total		57%	19%	7%	17%	100%	442	100%

* *Excluded are the doctoral graduates who reported no immediate plans.*

doctoral graduates. From this comparison among subfields, we can see that elementary particles and astrophysics recorded the highest proportions of 'postdocs', while mathematical physicists were more likely than other specialists to accept initial employment outside the U.S.

The lower portion of **Table X** separates the experimentalists from the theoreticians and subdivides each group into U.S. and foreign graduates. From this analysis we can conclude that as long as a graduate seeks a 'postdoc', the type of dissertation research appears to have little effect. We base this interpretation on the two percentage-point difference between U.S. experimentalists and theoreticians and the one percentage-point difference between the corresponding foreign 'postdocs'. A rather different scenario emerges when we examine the newly-accepted permanent positions. The totals appeared to indicate that those employers preferred experimentalists over theoreticians by a 3:2 ratio; however, a closer examination of the data showed that it is the citizenship within each group of researchers that is responsible for the substantial differences. For example, among the experimentalists, U.S. citizens are twice as likely as foreign citizens to be offered permanent positions, and among theoreticians the proportion of U.S. to foreign graduates is 6:1. The largest percentage in the column labeled "Seeking employment" is ten and it identifies the theoreticians who are U.S. citizens.

Less well known than the employment of 'postdocs' are the work activities and types of employers of those physicists who reported newly-accepted permanent positions. **Table XI** therefore singles out these physicists to show that industry is the single largest employer for whom they translate their discoveries into further contributions of technology. A notable change from the previous year was a seven percentage-point increase in research and development work performed by the new physicists. Another change worth noting was the decline in research positions at universities and a corresponding increase in teaching positions at colleges.

Table XI. Employment with potential permanence in the U.S. for 1990–91 physics doctorate recipients.

Work activity		Type of employer: University	College	Industry	FFRC	Government	Non-profit organization	Total N	Total %
Teaching		6	18	–	–	1	–	25	14
Research		4	–	6	3	9	3	25	14
Res. and teaching		13	15	–	–	–	–	28	16
Res. and dev.		2	–	45	13	9	3	72	41
Engineering		–	–	13	–	–	–	13	7
Consulting		1	–	3	3	3	–	10	6
Nonphysics professional		–	–	2	1	–	1	4	2
Total	N	26	33	69	20	22	7	177	
	%	15	19	39	11	12	4		100%
Extensive use of:	research method	88%	58%	76%	82%	88%	75%	132*	76%
	subject matter	94%	85%	68%	–	76%	88%	138*	75%

**Number of respondents to this question.*

Table XII. Median monthly starting salaries paid by U.S. employers to new physics degree recipients, 1990–91.

Type of employer	Bachelor's degree recipients		Terminal master's degree recipients		Doctorate recipients			
	Percentage accepting positions	Monthly starting salaries	Percentage accepting positions	Monthly starting salaries	Percentage accepting: 'postdocs'	Percentage accepting: potentially perm. pos.	Monthly starting sal. for: 'postdocs'	Monthly starting sal. for: potentially perm. pos.
Secondary school	9%	$2380	9%	$2440	–	–	–	–
College	1	*	[13	2270]	1%	5%	*	$3000
University	4	1850			49	4	$2420	3550
Industry	43	2510	43	2920	3	12	3710	4165
Gov't. incl. military	39	1920	25	2830	6	3	2830	3150
Fed. Funded Res. Ctr.	2	*	3	*	10	3	2830	4165
Other	2	*	7	*	2	2	2650	*
All employers	100%	$2085	100%	$2710	100%		$2560	$3660

**Insufficient data.*

Although the Graduate Student Survey collects salary data only from terminal masters and doctoral graduates, for purposes of comparison we include the starting salaries of physics bachelors in **Table XII**. The doctoral physicists are divided into two groups because those who accepted potentially permanent employment are paid significantly higher salaries than the graduates who start out as postdoctoral fellows. For all employers combined, only the doctorate recipients recorded significant changes in their median salaries from the previous year. The monthly median of $2560 for the postdoctoral fellows and the $3660 for those who accepted permanent positions represent 6% and 5% increases, respectively. Academic salaries were adjusted for the varying lengths of the school year-so that the dollar amounts apply to a month when a teacher is working.

ASTRONOMY

Unlike physics, the gradually rising astronomy enrollment since the mid 1980s cannot be attributed to foreign students. Each year we ask all graduate astronomy students to contribute information to this survey on their educational backgrounds, their level of graduate study, their areas of concentration, and their career plans. Analyses of these data can be found in **Tables XIII** and **XIV** and in **Figure IV**.

Table XIII. Graduate astronomy students* by subfield and years of graduate study, 1990–91.

		Full-time equivalent years of graduate study						Total	
		<1 yr.	2 yrs.	3 yrs.	4. yrs.	5 yrs.	≥6 yrs.	N	%
Distribution of students	N	192	167	132	132	123	134	880	
	%	22	19	15	15	14	15		100%
Astronomy subfields									
Astronomical instruments and techniques		6%	9%	9%	2%	3%	6%	51	6%
Cosmology, extragalactic objects, quasi-stellar objects		18	28	28	26	31	26	228	26
Galactic structure, stellar motions		7	6	4	6	10	5	55	6
Interstellar matter and gaseous nebulae		11	11	20	13	17	18	131	15
Solar system, space astronomy of the solar system		13	11	6	5	5	7	70	8
Stellar atmospheres and spectra, stellar evolution, solar and stellar interiors		14	15	10	21	14	20	140	16
Supernovae, X, y and cosmic rays, pulsars		7	7	4	6	6	5	53	6
The sun		2	4	2	6	4	2	29	3
Astrophysics		11	3	10	9	8	9	51	6
All other subfields combined		11	6	7	6	2	2	72	8
		100%	100%	100%	100%	100%	100%		

* *The percentages shown in this table are based on 584 respondents to the Graduate Student Survey. Astronomy department chairpersons reported a total of 880 graduate students for the survey of Enrollments and Degrees.*

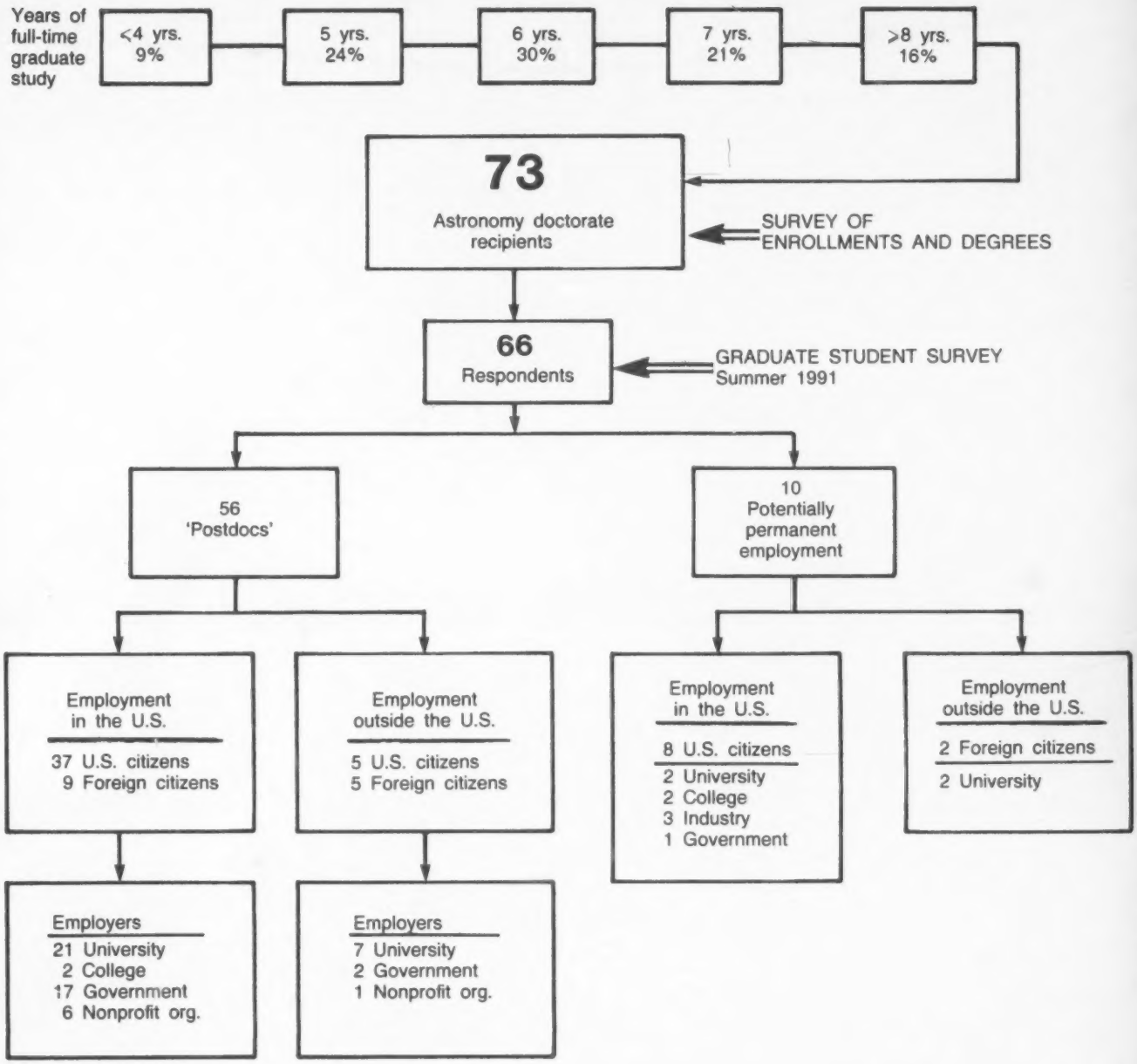
The distribution of students by level of study shown in **Table XIII** indicates that very few students leave astronomy after a master's degree. The total number of terminal masters in the class of 1991 was only 25, and are therefore not included in the characteristics table. **Table XIV** was given a similar format to **Table I** to facilitate comparisons between the graduate astronomy and physics populations. A comparison of the age groups of first-year students reveals that it is more common to enter graduate study in astronomy than in physics straight out of college; on the other hand, 29% of the beginning graduate physics students compared with 17% of the astronomers fell into the age groups of 27 to 32.

Table XIV. Characteristics of the graduate astronomy student population, 1990–91.

Characteristics		All graduate students	First-year graduate students	Doctorate recipients
	*Total population:	880	192	73
	Number of respondents:	584	109	66
Sex	Female	20%	25%	16%*
	Male	80	75	84
Citizenship*	U.S.	71%	70%	79%
	Foreign	29	30	21
Age	24 or younger	20%	57%	–
	25–26	25	17	6%
	27–28	25	7	23
	29–32	20	10	47
	33 or older	10	9	24
High school physics	Yes	94%	92%	94%
	No	6	8	6
Major of bachelor's degree	Astronomy	34%	31%	32%
	Physics	53	54	55
	Engineering	4	6	5
	Mathematics	3	3	5
	Other	6	6	3
Type of bachelor's institution	PhD granting	58%	57%	60%
	MS granting	2	2	2
	BS/BA granting	18	24	15
	Foreign	22	17	23
Type of graduate institution*	PhD granting	95%	95%	100%
	MS granting	5	5	–
	Public	70%	73%	64%
	Private	30	27	36
Source of support	Teaching assistantship	27%	48%	8%
	Research assistantship	47	22	68
	Fellowship	17	22	19
	Family, savings, loan	2	1	5
	Foreign government	1	1	–
	Other	6	6	–

* *These data were reported by astronomy department chairpersons as part of the survey of Enrollments and Degrees.*

Figure IV. Characteristics and post-doctorate status of 1990–91 astronomy graduates.



With an increasing proportion of graduates leaving the U.S. for their initial employment, we expanded **Figure IV** to include both U.S. and foreign employers as well as the citizenship of the doctoral astronomers. Foreign graduates who wished to remain in the U.S. were offered 'postdocs' exclusively. Compared with physics, a smaller proportion of the astronomy 'postdocs' were at universities, yet their salaries were almost identical to the median recorded for the physicists.

This report was prepared with the help of Thomas N. Stovall.